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Rural Land Titling and Property Rights: Does Legislating Smallholdings as Non-seizable Family Assets Improve Smallholder Farmers' Welfare?[1][2]

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Abstract

Land titling and property rights have been the central tenant of agricultural and rural development policy for many years since land is one of the key assets for production of agricultural goods and services. Land titling facilitates access to credit through collateral arrangement, thereby induces on-farm investment and improves agricultural productivity. This paper evaluates a particular policy in Bolivia, where legislation limits legally defined smallholding's farm and ranch lands from being used as collateral, in order to prevent small landowners from selling out their land in response to temporary shocks and safeguarding smallholders' source of income, avoiding the seizure of their assets. This study analyzes the effect of this policy on land prices, to investigate whether smallholders' welfare is improved by this protective measure or not, assessing if the positive impact of the land risk premium generated by the non-seizability, has a bigger effect than the negative impact of the capital constraint reducing optimal investment. Differences in land prices are assumed to reflect differences in expected future profits, thereby used as a measure of welfare. We use a unique dataset of 2,609 recorded land transactions in the Department of Santa Cruz, Bolivia, during the period between 2010 and 2015 to determine whether being a smallholding affects land price per hectare. We refine our analysis considering small neighborhood variations near the cutoff value for "small farms" and "small ranches" to account for other unobservable exogenous factors affecting land prices other than non-seizability. Results indicate that the effects are heterogenous among the classifications of farms and ranches. The price of ranch lands is negatively associated with the legal definition of "small" ranch, implying that the negative effect of capital constraint dominates the positive effect of land risk premium, while the opposite is true for farm lands— land prices are higher for "small-holdings". Our findings have important policy implications, and the potential to increase their efficiency, for instance a plausible option would be the implementation of differentiated land legislation policies given the type of land, and another would be to allow farmers and ranchers to self-select into the legal classifications of land, which could potentially improve the welfare of those negatively affected by the restriction.

Keywords: Bolivia, Land titling, Property Rights, Smallholders.
JEL codes: Q12, Q15.

"Smallholder family farming—small farms that rely mainly on family labor—is the backbone of agricultural production in developing countries. According to the United Nations Food and Agriculture Organization (FAO), four-fifths of the developing world's food is a product of small-sized farms. Small, family-run farms are also home to the majority of people living in absolute poverty, and half of the world's undernourished people." (IFPRI)

Land titling and property rights have been of interest in agricultural economics for many years because land is the main production asset for agricultural activity. Land titling ensures tenure security and facilitates farmer's willingness to undertake fixed investment, thereby increasing agricultural productivity. Securing landownership and farmer's ability to use land as collateral can increase the supply of credit from formal sources (Deninger and Biswanger). The positive association between the degree of land ownership security through titling and on-farm investment and agricultural productivity has encourage many countries around the world to implement titling programs in recent years. Countries in Asia (China and Vietnam), Africa (Uganda, Tanzania and Zambia) and Latin-America (Colombia, Ecuador, Peru and Bolivia) have provided land titles to farmers who previously did not have their titles updated or simply did not have them at all. The effects of these policies on agriculture follow different channels: i) decreasing the risk of losing the land (due to conflict or land disputes) and any other investment on it like irrigation, ii) making investments on technology more attractive which may increase productivity, iii) facilitating ownership transferability which in turn provides an efficient allocation of resources among farmers, and iv) allowing access to credit, and reduction of costs through land collateralization (Galiani and Schargrodsky). In this paper, we study the effect of a Bolivian land legislation policy that limits legally defined smallholdings from being used as collateral to avoid the seizure of their assets thereby safeguarding smallholders' source of income. For this analysis, we investigate the effect of being a smallholding on land prices assuming that land prices reflect all future profits and investments made on land.

To implement land titling reform programs, many international organizations have provided financial and technical support to various governments widely in Africa, Asia and Latin America. The Inter-American Development Bank (IDB) has financed a series of land titling projects in Latin America to enhance the growth of the agricultural sector, its contribution to the gross domestic product (GDP), and its effect on poverty reduction. In the Development Effectiveness Overview by the IDB it is discussed that "the primary goals of land-titling projects is: to increase land security and reduction of conflicts or land disputes, incentivize productive investments so as to increase household income by improving farm productivity and efficient resource allocation; to facilitate access to credit and stimulate credit markets using land titles as collateral; to stimulate rental and land sale markets; and to increase the value of the property" (IDB, 2010).

Land titling in Bolivia

Bolivia's GDP grew on average 4.2 percent yearly between 2002 and 2014 (World Bank). During the same period, the agricultural sector contributed 13.4 percent to the GDP, generated 40 percent of total national employment, and provided 10 percent of the country export earnings.

Because agricultural activity is the mainstay of rural household economy, its contribution to poverty reduction is critical. For example, a study by Castellani and Zenteno showed that

extreme rural poverty levels decreased by 21 percentage points, from 60 percent in 2000 to 39 percent in 2013. Although there is significant poverty reduction, extreme poverty is still four times higher in rural areas than in urban areas.

Despite the importance of agriculture in the economy of Bolivia, previous findings showed that there is limited gain in land productivity relative to other South American countries. For example, cereal yields were only 57 percent of the region's average, and tuber yields were 39 percent of the South American averages (Salazar et. al.). In addition, total factor productivity (TFP) growth in Bolivian agriculture was 0.78 percent relative to the regional average 2.29 percent between 2000 and 2009 (Trindade and Fulginiti), with a decrease in technical efficiency despite marginal increases in technological change (Nin-Pratt et. al). Another study by Silva et. al shows that in Bolivia the municipality average technical efficiency is 0.75 (with 1 being on the production frontier), and there is a positive response at the municipality level to investment in trucks (elasticity of 0.345) and water pumps (elasticity of 0.13). In the period 2006-2014, data from Unidad de Análisis de Políticas Sociales y Económicas of the Planification Department of Bolivia (UDAPE) revealed that crop area has increased more than 1.14 million acres (460,000 hectares). This supports the notion that most significant growth in agricultural production was driven largely by area expansion, with little productivity gain. Given the importance of the agricultural sector, policies intended to prioritize investment in agriculture and spur agricultural productivity are pivotal to improve economic growth and reduce rural poverty in Bolivia, which includes mainly smallholders residing in rural areas.

To achieve agricultural productivity improvements, an increase on private investment on farms and ranches is necessary. Achieving such objectives can be realized by promoting policies that establish property rights over rural land. Rural development theory indicates that these rights reduce the risk of expropriation (due to conflict or land dispute), providing incentives to farmers to engage in long term investments that increase land productivity (IDB Office of Evaluation and Oversight (IDB-OVE)). Moreover, empirical evidence indicates that legal certainty over land property rights is one of agricultural investment determinants, improving food security and farmers' income (Lawry et. al.; Rockson et. al.). Securing land ownership is likely to increase the supply of credit from the formal credit system to undertake on-farm investment (Hayami and Otsuka). Feder and Noronha documented several studies in their citation that show the effect of securing land ownership and farm productivity and efficiency in Asia and Latin America. For example, a study in Costa Rica showed a positive association between the degree of ownership security and farm investment per unit of land (Salas et. al). In Brazil, capital per hectare is substantially higher on titled farms than on undocumented or encroached land (Villamizar). In Thailand, Feder and Onchan found that the possession of secure ownership affects positively the likelihood of investing in land improvements.

Given the positive outcomes of land titling, the government of Bolivia has considered land titling as a critical component among a series of policy reforms to foster growth and development in the agricultural sector, in order to support its rural economy and meet broad-based poverty reduction strategies. The Bolivian government has made considerable progress by titling 70 percent of the rural land (out of 101 million hectares) since 1996, and it is expecting to title the remaining 30 percent within the next five years. The National Institute of Agrarian Reform (Instituto Nacional de Reforma Agraria -INRA-) was created by the 1715 law of 1996, with the mandate of processing for completing titling of the lands by 2013. The 429 law of 2013 extended that period until 2017.

Since 2002, IDB has supported the titling process in Bolivia with two operations (1099/SF-BO y 1512/SF-BO) titling 48 million acres of rural land, and currently is financing a new operation (BO-L1113) to title 25 million hectares (62 million acres), of which 80 percent are small farms in the highlands that are mostly possessed by indigenous people. Between 2005 and 2012 with the IDB loan, 1099/SF-BO, INRA provided titles for 7.9 million hectares and 25.8 thousand farms out of a total of 36.8 million hectares in Santa Cruz, where the most productive land is located. More than 96 percent of the titles were given to small properties, representing 36 percent of the private land titled in Santa Cruz. Thus far, the government has titled 72 percent of Santa Cruz farm land and has recorded land transactions after titles were issued.

Smallholding as non-seizable assets

The Bolivian constitution states that smallholders' land is a non-seizable family asset, legally restricting small farm and small ranch owners from using their land as collateral. A probable justification is to protect farmers from losing their land, due to temporary negative economic shocks and limited financial literacy. Rural areas are characterized by the presence of extreme poverty, and a significant affected segment of the population which is highly vulnerable. The aim of this paper is to evaluate the impact of a land policy that restricts smallholding farmers and ranchers from using their land as collateral on their land value and its welfare implications.

Article 394 II of the Bolivian Constitution aims to protect smallholders and ranchers from losing their land in case of distress sell (avoiding seizure due to bankruptcy) and from partitioning it into smaller production units. The article states: "The small property is the source of subsistence of the owner and its family. It is indivisible, and it is a non-seizable family asset." A small property in the Lowlands (Oriente), where Santa Cruz department is located is defined as farm land having less than 50 hectares (124 acres) and ranch land having less than 500 hectares (1236 acres). In the Highlands (Altiplano), small property's thresholds are smaller than Santa Cruz. Such policy in Bolivia may significantly increase transaction costs and access of working capital, where interest rates for non-collateralized credit may be higher, compared to credits with land used as collateral, as credits to the agricultural sector are classified in three categories: i) Collateralized credit, ii) Credit by stored product, and iii) Credit by production contracts (Autoridad de Supervisión del Sistema Financiero). It may also affect the probability of non-collateralized credit approval, thereby creating a credit constraint. We assess the net effect of the policy that may include on one hand the reduction of the risk of seizure (the Constitution makes the smallholding land a risk-free asset), and on the other hand the policy may possibly increase the cost of owning capital which would reduce the optimal investment per acre, and therefore future profits, land value and welfare. Hence, the ex-ante net effect of this policy on smallholdings is undetermined.

Given the uncertain outcome of Article 394 II on land values and its implication of farmers and ranchers' welfare, ex-post evaluation of the outcomes and empirical evidence is particularly relevant. Moreover, it is noticeable to consider that smallholders and ranchers have requested a regulatory reform to the government of Bolivia to be able to choose whether to use their land as collateral or not. As such, the aim of this study is to evaluate if a regulatory reform is necessary, and whether other policies can be implemented to improve farmers and ranchers' welfare.

Data and Descriptive Statistics

A unique database of 2,642 recorded land transactions involving 598,626 hectares (1,479,237 acres) in 44 Municipalities of Santa Cruz Department between the year 2010 and 2015 is used for the first time in this paper. The database is cleared of price per hectare outliers, by removing

observations with zero US$/hectare on record, and observations further than 1.98 price per hectare standard deviations from the mean. The following variables are considered in this study: declared sale price (US$/hectare), land surface (hectares), smallholding legal classification (Small), classification (Ranch, Farm, Mixed production, Other, No data), Municipality level US$/per hectare Gross Production Value (GPV) and Gross Coca Production Value (GPV Coca), which is a municipal average of the Gross Coca Production Value per hectare, we include this variable in the analysis since Coca is a high value crop that is traditionally produced in Bolivian low lands.

Overall statistics provide key characteristics of rural properties. Total transactions represent more than half a million hectares (almost 1.5 million acres) with most of the transactions being farms (58%), and most of the surface being ranches (84%). The average farm and ranch sizes (56.4 and 460 hectares) are close to their respective legal smallholding threshold, and smallholdings represent the vast majority of total transactions (84.5%) and the minority of the traded surface (26.3%). On average farm land is more expensive than ranch land (US$2,175 vs. US$1,506), and large farms have higher price per hectare than small farms (US$2,905 vs. US$1,084; Table 2)); with the same happening to ranches (US$1,679 vs. US$977; Table 3).

Detailed descriptive statistics are presented in Tables 1 to 3. Table 1 shows simple and surface weighted statistics for all land transactions, Table 2 for farms, Table 3 for ranches, including farms and ranches statistics by legal type (small or large). Out of all the properties sold, 58 percent were farms and 41 percent were ranches (Table 1). The average sold property has a surface of 227 hectares (Table 1); 56.4 hectares for farms (Table 2) and 460 hectares for ranches (Table 3), with a weighted average sale price per hectare of US$ 1,586 (Table 1); US$ 2,175 for farms (Table 2) and US$1,506 for ranches (Table 3). There is a significant variation on land sale prices, from US$ 59.9 to US$ 21,987 per hectare (Table 1).

Smallholdings represent 84.5 percent of the total transactions (Table 1); 86.9 percent of farms' total transactions (Table 2) and 82.4 percent of ranches' total transactions (Table 3). Large farms have an average transaction price of US$ 2,905 per hectare, and an average GVP/hectare at the municipality level of US$ 4,339; while small farms (legally defined as having an area of no more than 50 hectares) have an average transaction price of US$ 1084 per hectare, and an average GVP/hectare at the municipality level of US$3,226 (Table 2). On the other side, large ranches have an average transaction price of US$ 1,679 per hectare, and an average GVP/hectare at the municipality level of US$ 1,607; while small ranches (legally defined as having an area of no more than 500 hectares) have an average transaction price of US$ 977 per hectare, and an average GVP/hectare at the municipality level of US$ 2,218 (Table 3).

Econometric framework

We use ordinary least square (OLS) and weighted least square (WLS) to empirically estimate the effect of the policy taking land transaction prices (US$/hectare) as the dependent variable using a unique data set containing 2,609 rural land sales in Santa Cruz Department for the period 2010-2015. In the estimation, we use explanatory variables: farm/ranch area in hectares, land type (agriculture farm or ranch), average Gross Production Value (GPV in US$/hectare) and GPV of Coca (in US$/hectare) at the municipality level, year and municipality fixed effects. The municipality fixed effects (53 different municipalities) allow us to control for time-invariant unobservable characteristics of each municipality, capturing spatial variation in soil quality, road access, and distance to markets. Equation 1 presents the general functional form of the estimated models:

$$\underset{it}{\mathrm{P}} = \omega_i + \mathrm{t_i} + \beta_1 Area + \beta_2 Farm + \beta_3 Small + \beta_4 Small * Farm + \beta_5 GVP + \beta_6 GVPCoca + \beta_7 Year + \varepsilon_{it} \quad (1)$$

Where P_{it} is the declared purchase price of the property in municipality i at time t, $Area$ depicts area of land in hectares, the dummy $Farm$ represents the type of land (agriculture or ranch), GVP and $GVPCoca$ represent average Gross Production Value (GPV in US$) per hectare, and GPV of Coca per hectare at the municipality level according to the 2013 Agricultural Census, ω_i and $\mathrm{t_i}$ are municipality and year - fixed effects. The coefficients of interest in the analysis are those that capture the effect of being a small holding on price. We include an interaction term, $Small * Farm$ to account for the potential differential effect of being a small holding by land type. The effects could be different by land type since they have different restriction thresholds from which they are defined "smallholdings" (50 hectares for farms and 500 hectares for ranches), different characteristics of their production processes, capital requirements, and possible different risk preferences between ranchers and farmers. The measurement and specification error component, ε_{it}, represents individual municipality heterogeneity, stochastic and time elements. We assume that ε_{it} is normally distributed with mean zero and constant variance.

Additionally, we run separate regressions for farms and ranches. To account for other unobservable characteristics not controlled in the general formula proposed that may be varying with size and to determine how robust results are, we run regressions with subsets of the dataset restricting the land size around the limit between small and large properties. The smallest subsets are from 49 to 51 hectares for farms and 490 to 510 hectares for ranches. We assume that the observations in these subsets will be similar in all other characteristics aside from being defined a smallholding. Therefore, the regressions in these subsets will capture the "smallholding" definition effect and the constraints and benefits that come with it.

Results and discussion

We present the results of the models by type of property: Farms and Ranches, as property types are structurally different in terms of investment, production, and other relevant factors. We fit separate OLS and WLS models for both property types. Given that a sale price represents the average price of each hectare at the rural property sold, and that price varies depending on the size of the property, a WLS model with property area as weight is more appropriate to estimate the average effect of smallholding legal classification on land values. In addition, we include the property size to control for relationships between size and productivity.

The different model specifications in Table 4 and 5 include the following fixed effects: the municipality where the property is located (Municipality, results omitted from the table), and the sale year (Year, results omitted from the table). Property area and its quadratic term where also included in some models, with results indicating an increase in the value per hectare the larger the property at an extremely small but significant decreasing rate. Including the property area allows us to control for the farm-size productivity relationship.

In the case of farms, the effect of being a smallholding has a positive effect on land prices (Table 4). Both OLS and WLS specification show statistically significant positive results, except for column 4, the WLS specification that does not control for area squared, GVP/hectare and GPV Coca/hectare. With all the controls, the WLS specification in column 6 shows that being a smallholding implies an increase in the land value of US$ 509 per hectare for farms, which

represents a 18% price premium of the large farms' weighted average sale price of US$ 2,905 per hectare (Table 2). For farms, the positive effect of being a smallholding on land values (risk premium reduction), dominates the negative effects generated by the non-collateralizable asset and possible credit constraint restrictions

In the case of ranches the opposite is true, the effect of being a smallholding has a negative effect on land prices (Table 5). All the specifications for both OLS and WLS show negative effects of being a smallholding. The results for the OLS specifications are significant at the 90% confidence level, while those for the WLS specifications are significant at the 99.9 and 95% confidence level controlling for area squared. The classification of smallholding implies on average a loss from US$44.65 to US$433.8 per hectare on the value of the ranch (column 4 and 5). Smallholding ranches present a 2.7% price discount (US$44.65) of the large ranches' weighted average sale price of US$ 1,679. For the ranches, being a small holding has a negative net effect, which implies that the negative effect of this legal definition (credit constraint, etc.) is bigger than the risk reduction effect perceived by the market.

In order to identify the effect more precisely, we conduct a sensitivity analysis of the farms' and ranches' results using WLS models and progressively reducing the estimation range (Has) around the smallholdings' surface legal limit using subsets of the observations (the ones that are within that estimation range). In the case of farmland prices (Table 6), all twelve estimation ranges (Has) present significant positive effects of being a legally defined smallholding on farm land prices. The smallholding legal definition increases the value of the land by US$139 for farms with land sizes between 45 and 55 hectares, and by US$ 298 for farms with land sizes between 49 and 51 hectares, which we assume are fairly similar in all other characteristics. These results imply a stable positive effect of being a smallholding, even for those properties in the neighborhood of the legal definition which, we assume, is the only difference. Therefore, we conclude that the smallholding definition only, with all other characteristics constant, has a positive effect on farm values.

On the other hand, Table 7 presents the results for ranches, where all twelve estimation ranges consistently show significant negative effects of being a smallholding.

The effect of being a smallholding has consistent differential effects by property type. While we cannot test the channels or mechanisms behind this differential effect, we present some potential reasons of this difference. In principle we anticipated both a positive and a negative effect of being a smallholding on land prices—being a smallholding has a risk reduction effect as the asset is non-seizable which would imply a positive effect in the land market value. On the other hand, the non-seizability would imply higher restrictions on credit, which in turn would imply lower investment levels and productivity if the farmer or rancher has capital constraints, which would be reflected in a lower price. The net effect of these two channels is different by land type. In the case of the farmland the positive effect has a bigger impact, while for the ranchland the opposite happens. Some of the potential reasons are:

1. The larger the smallholding threshold, the more probable that credit constraint is binding given more investment is required for larger properties. The opposite is true for smaller properties. Given the threshold for small ranchers is ten times larger than for farmers (500 vs. 50 hectares), ceteris paribus, it is more probable that small ranchers are more affected than small farmers on their credit access. This could make the restriction binding for more ranch land, compared to farm land.

2. If the capital requirements per hectare are bigger for ranchers, credit constraints for the same property size may be larger for them. This could imply that if farmers' capital requirements are smaller per hectare, they could be covered through credit without land collateral requirements, such as consumption credits. This reason could potentiate the previous one: smaller threshold and smaller investment per hectare requires less total investment for farmers, reducing the possibility of a binding credit constraint compared to ranchers.

3. Seed and agrochemical companies in Bolivia provide credit to farmers to buy commodity crop inputs during the crop season, making the lack of collateral probably more binding to ranchers that need to make longer term investments on livestock and pastures.

4. Risk exposure may be different between farmers and ranchers. If farms' total production losses are more frequent than ranchers' total losses (or large ones) implying the probability of bankruptcy is larger ceteris paribus and the expected benefits of having non-seizable land larger (larger risk premium benefits). Thus, risk premium benefits may be smaller for ranchers than farmers, increasing the probability that the effect of being a smallholding is negative for ranchers and positive for farmers. Larger risk exposure in farmers may also increase the need for credit to smooth consumption and production, but this is not a reason for farmers to be better off than ranchers as smallholdings since it goes in the opposite direction.

5. Risk aversion may also be different between farmers and ranchers. Results presented in this paper may be supported if farmers are more risk averse than ranchers, since the more risk averse, the less effect of credit constraint on investment and the more effect on land risk premium, making more probable that the net effect on land prices of being a smallholding is positive.

6. It may be the case that smaller farms have more fertile land, which may force less fertile farms to expand their production area in order to get same production levels, this would imply a differential impact on the relationship size-price by property type. To control for different land quality, we include municipality fixed effects, however a more precise estimation would require data on land quality.

7. Additionally, it can be the case that land parcels that are closer to the city or municipality centers are smaller and have higher prices, than land parcels that are further away which could be reflecting higher transportation costs which have different implications by property type.

The results presented here provide evidence that legally declaring land as a non-seizable asset has significant effects on the asset value, which may affect optimal investment and productivity. These findings also illustrate how difficult it is to forecast ex-ante the effects of these type of policies.

Conclusions

Many theoretical and empirical studies show the positive effects of land titling and property rights for agricultural development. The positive effects of property rights are realized through the following channels: i) decreasing the risk of expropriation due to conflict or disputes, ii) making

investments on land more attractive, as they increase the confidence that future returns will be realized by the owner iii) facilitating a better allocation of the resources among farmers, and finally iv) incentivizing investment through credit by enabling credit access through land collateralization.

In Bolivia, there has been an intensive process of rural land titling, in addition the constitution of the country states that smallholders' land is a non-seizable family asset, legally restricting small-farm and ranch owners from using their land as collateral, aiming to protect this vulnerable sector of producers. This law intents to protect small farmers and ranchers from losing their land, which implies a reduction in the risk of the asset, however if the owners of the land do not have capital on their own, or other assets to use as collateral this restriction may be acting as a constraint on optimal investment, increasing credit costs or preventing the producers to get credits at all.

We find that declaring smallholders land a non-seizable family asset to protect their property may come at a net cost to some ranchers, by reducing land values, probably due to less access to credit, lower investment and reduced future profits, and a net benefit to some farmers due to the risk reduction of losing their smallholding. This paper presents evidence supporting the idea that on average, the net effect of declaring land as non-seizabe is negative for ranches, reducing the price of their land by US$ 44.65 per hectare, and positive for farms increasing the price of their land by US$ 509 per hectare. This implies that the risk reduction effect over the asset price, the land risk premium associated with the fact that this land cannot be expropriated in any circumstances, is smaller than the negative effect of the investment constraint caused by the lack of a significant collateral to access capital at a lower cost for Bolivian ranchers, and the opposite happens for Bolivian farmers.

Given that we are considering average effects, we should also consider the case of ranchers that do not want to use their land as collateral. In that case, they should benefit from this policy, while on the other side the ones that lose the possibility of using their land as credit collateral may not be better off, and the case of farmers which are negatively affected by the credit constraint due to the lack of collateralizable land. The question is how to identify both types of farmers and ranchers, the ones who have benefited from this policy and the ones who did not, self-selection may be the answer.

In the case of Bolivia, a regulatory change allowing the smallholders to opt out of small property may be welfare improving by allowing them to use their land as collateral, assuming land owners are financially literate. Especially in the case of farmers/ranchers who have no previous experience with the credit market and may lack financial literacy. It is possible that if farmers or ranchers lack financial literacy, the benefits from land value appreciation may be smaller than expected loses due to the risk of not being able to manage debt, in which case this constitutional policy may have prevented farmers from losing their land, and therefore may have reduced poverty. If a policy change allowing to choose whether to be a small farmer/rancher is implemented, it may be beneficial to the farmers/ranchers that a financial education program is provided, as a prerequisite to opt out of being a legally defined smallholder.

A change of regulations may produce instantaneous, medium-term, and long-term effects. A reduction on interest rates on credits would be an instantaneous effect, while an increase in investment will be a medium-term effect. The impact of these investments on production levels may take at least one calendar year in the case of agriculture, and it may take 4 to 5 years to be reflected on cattle production given the average cattle slaughter age.

Another option may be reducing the threshold for ranchers, since a smaller threshold for farmers has a positive average effect on the land value.

Future research is required to answer whether reduced thresholds for farmers, or a self-selection policy would be beneficial. Especially in the case of self-selection, where the potential gains are big (all nonoptimal levels of investment could increase) but financially illiterate smallholders may be harmed, as they may be at risk of making welfare-decreasing financial decisions; and if necessary mechanisms might need to be designed to reduce the risk of borrowing by improving the understanding of borrowing implications by low income smallholders. To better understand the remaining puzzle, it is also necessary to continue studying possible differences in risk exposure and risk aversion between farmers and ranchers, and their effect on non-seizable land prices.

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Table 1. Summary Statistics

Variable	Obs	Mean	Std. Dev.
Simple statistics			
US$/hectare	2,642	1,858	3,009
Area (hectares)	2,642	227	642
Classification			
Small	2,642	0.844	0.362
Farm	2,642	0.580	0.494
Ranch	2,642	0.413	0.492
Mix production	2,642	0.0011	0.027
Other	2,642	0.003	0.055
No data	2,642	0.0004	0.019
GPV / hectare	2,574	2,687	1,751
GPV Coca/hectare	2,574	0.0002	0.001
Surface weighted statistics			
US$/hectare	598,626	1,586	3,193
Area (hectares)	598,626	2,046	1,654
Classification			
Small	598,626	0.263	0.440
Farm	598,626	0.143	0.350
Ranch	598,626	0.838	0.368
Mix production	598,626	0.0002	0.016
Other	598,626	0.0001	0.009
No data	598,626	0.00004	0.007
GPV / hectare	564,711	2,076	1,728
GPV Coca/hectare	564,711	0.0001	0.001

GPV= Gross Production Value

Table 2. Farm Summary Statistics

Farm Summary Statistics - All sample

Variable	Obs	Mean	Std. Dev.
US$/hectare	1,533	2,080	3,224
Area (hectares)	1,533	56.37	238
Small	1,533	0.869	0.336
GPV / hectare	1,510	3,103	1,863
GPV Coca/hectare	1,510	0.0002	0.001
Surface weighted statistics – All sample			
US$/hectare	85,673	2,175	4,253
Area (hectares)	85,673	1,068	1,321
Small	85,673	0.401	0.490
GPV / hectare	84,361	3,898	2,163
GPV Coca/hectare	84,361	0.0001	0.0005
by Legal Type			
Large			
US$/hectare	51,328	2905	5210
Area (hectares)	51,328	1,756	1,314
GPV / hectare	50,929	4,339	2,167
GPV Coca/hectare	50,929	0.00002	0.0001436
Small			
US$/hectare	34,345	1,084	1,602
Area (hectares)	34,345	38	12.54
GPV / hectare	33,432	3,226	1,975
GPV Coca/hectare	33,432	0.0002	0.0007

Table 3. Ranch Summary Statistics

Ranch Summary Statistics - All sample

Variable	Obs	Mean	Std. Dev.
US$/hectare	1,091	1,534	2,603
Area (hectares)	1,091	460	901
Small	1,091	0.824	0.381
GPV / hectare	1,046	2,101	1,380
GPV Coca/hectare	1,046	0.0002	0.001
Surface weighted statistics – All sample			
US$/hectare	501,785	1,507	2,994
Area (hectares)	501,785	2,224	1,662
Small	501,785	0.246	0.431
GPV / hectare	469,182	1,762	1,422
GPV Coca/hectare	469,182	0.0001	0.0007
by Legal Type			
Large			
US$/hectare	378,439	1,679	3,305
Area (hectares)	378,439	2,848	1,442
GPV / hectare	350,013	1,608	1,404
GPV Coca/hectare	350,013	0	0
Small			
US$/hectare	123,346	977	1612
Area (hectares)	123,346	313	168
GPV / hectare	119,169	2,218	1,376
GPV Coca/hectare	119,169	0.0002	0.001

Table 4. Farms Regressions

Variables\Models	(1) OLS	(2) OLS	(3) OLS	(4) WLS	(5) WLS	(6) WLS
Small	320.5**	377.6***	384.0***	-368.0***	502.8***	508.8***
	(101.5)	(107.0)	(107.7)	(26.16)	(23.71)	(23.97)
Area (hectares)	1.067	2.043	2.052	1.594***	5.689***	5.696***
	(0.919)	(1.709)	(1.708)	(0.0254)	(0.0670)	(0.0670)
Areasq (sq hect)		-0.000402	-0.000405		-0.00142***	-0.00143***
		(0.000419)	(0.000418)		(0.0000161)	(0.0000162)
Municipality-level controls		Yes	Yes		Yes	Yes
GPV / hectare		Yes	Yes		Yes	Yes
GPV Coca/hectare			Yes			Yes
Constant	148.8	123.7	114.5	-4034.1***	631.6***	621.4***
	(417.2)	(420.2)	(420.5)	(130.0)	(82.42)	(82.71)
R^2	0.345	0.345	0.344	0.308	0.355	0.354
AIC	28488	28489.1	28080.0	1639768.2	1633686.6	1609832.4
Observations	1,529	1,529	1,506	85,476	85,476	84,164

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. WLS=Weighted Least Squares. *All models have Municipality and sale year fixed effects. Standard Errors are Robust. Similar results are obtained with Clustered Standard Errors at the Municipality level.*

Table 5. Ranches Regressions

Variables\Models	(1) OLS	(2) OLS	(3) OLS	(4) WLS	(5) WLS	(6) WLS
Small	-292.8	-715.5^{+}	-726.5^{+}	-433.8***	-44.65*	-31.59^{+}
	(289.0)	(418.4)	(430.0)	(10.67)	(17.47)	(18.32)
Area (hectares)	0.174	-0.509	-0.514	0.299***	0.817***	0.830***
	(0.167)	(0.558)	(0.565)	(0.00293)	(0.0177)	(0.0182)
Areasq (sq hect)		0.000137	0.000139		-0.0000880***	-0.0000885***
		(0.00008)	(0.00009)		(0.0000026)	(0.00000268)
Municipality-level controls		Yes	Yes		Yes	Yes
GPV / hectare		Yes	Yes		Yes	Yes
GPV Coca/hectare			Yes			Yes
Constant	-484.2	65.13	67.80	320.0***	-210.4***	-251.2***
	(513.9)	(673.9)	(679.6)	(54.99)	(63.29)	(62.39)
R^2	0.332	0.334	0.331	0.529	0.530	0.526
AIC	19232.8	19232.0	18553.4	7909064.3	7907675.3	7551999.9
Observations	1052	1052	1013	434091	434091	413495

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. WLS=Weighted Least Squares. *All models have Municipality and sale year fixed effects. Standard Errors are Robust. Similar results are obtained with Clustered Standard Errors at the Municipality level.*

Table 6. Farms neighborhood variation (has)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Has	0-500	0-300	0-200	0-100	25-75	35-65	40-60	45-55	46-54	47-53	48-52	49-51
Small	**41.42****	**114.8*****	**114.8*****	**397.7*****	**135.1*****	**153.3*****	**99.31*****	**138.7*****	**178.6*****	**162.4*****	**100.8*****	**298.0*****
	(13.28)	(13.70)	(13.70)	(17.58)	(13.73)	(13.99)	(14.97)	(19.02)	(22.49)	(23.28)	(24.06)	(41.30)
R^2	0.236	0.234	0.234	0.233	0.209	0.254	0.314	0.297	0.292	0.307	0.328	0.186
AIC	7.6 e+05	7.3 e+05	7.3 e+05	7.3 e+05	5.9 e+05	5.1 e+05	4.4 e+05	3.4 e+05	3.3 e+05	3.0 e+05	2.6 e+05	1.9 e+05
N	1510	1503	1503	1498	867	688	547	460	427	386	341	246

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*. WLS models. Control variables include Area (hectares), Area squared (hectares sq.), GPV / hectare, and GPV Coca/hectare (not presented in this table). All models have Municipality and sale year fix effects. Standard Errors are Robust. Similar results are obtained with Clustered Standard Errors at the Municipality level.*

Table 7. Ranches neighborhood variation (has)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Has	0-2000	0-1500	0-1300	0-1000	100-900	250-750	400-600	450-550	460-540	470-530	480-520	490-510
Small	**-812.1*****	**-1011*****	**-884.3*****	**-752.5*****	**-92.94*****	**-367.2*****	**-2144*****	**-3267*****	**-3496*****	**-6988*****	**-6988*****	**-2119*****
	(19.39)	(19.64)	(22.60)	(28.43)	(28.16)	(28.93)	(48.64)	(42.32)	(49.72)	(39.06)	(39.06)	(81.77)
R^2	0.733	0.764	0.762	0.772	0.282	0.305	0.440	0.616	0.622	0.710	0.708	0.823
AIC	4.0 e+05	3.5 e+05	2.9 e+05	2.7 e+05	2.1 e+05	1.6 e+052	9.1 e+05	7.1 e+05	5.8 e+05	5.3 e+05	5.2 e+05	4.0 e+05
N	1015	994	973	957	359	239	121	95	79	72	69	55

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. *WLS models. Control variables include Area (hectares), Area squared (hectares sq.), GPV / hectare, and GPV Coca/hectare (not presented in this table). All models have Municipality and sale year fix effects. Standard Errors are Robust. Similar results are obtained with Clustered Standard Errors at the Municipality level.*

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